THE GEO-ELECTRICAL RESISTIVITY SURVEY IN JALINGO LOCAL GOVERNMENT AREA OF NORTHERN TARABA STATE, NIGERIA

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ABSTRACT
The Geo-electrical Resistivity survey in Jalingo Local Government Area in the Northern Taraba State, Nigeria was carried out with the aim to tackle Water Scarcity problem so as to improve portable water supply with the following objectives: to explore Geo electrical resistivity method; vertical electrical sounding (VES) method in particular to analyses geo-electrical parameters to the subsurface layering in terms of apparent resistivity, thicknesses, depths to the aquifer as tool attempting to evaluate ground water potentials in the study area. VES was carried out in ten locations within six satellite villages namely Jekadafri, Jenbambu, Kona, Magami, Sabongari and Shavung, distributed as follows: three (3) each in Sabongari and Shavung with one(1) each in Kona, Magami, Jekadafari and Jenbambu. The characteristic curves of resistivity data obtained from ABEM SAS 300 terrameter system analyzed using OFFIX-TM generally shows three to four layers with resistivity ranges as follows: first layer (Resistive top soil) ranges from 165.4 to 2446.9 Ωm, second layer (saturated zone) ranges from 144.0 to 2578.9 Ωm while third and fourth layers (resistive basement) ranges from 343.9 to 7359 Ωm over the selected locations of the study area. It was also found that in the study area the H-curve and A- curve types were obtained with six VES points(02, 03, 04, 08, 09 and 10) are the H-type while four(02, 05, 06 and 07) are the A-type . The H-type dominate with 60% over the A-type being 40%, VES stations 02, 03, 04, 08, 09 and 10 are suitable for drilling sites white 01, 05, 06 and 07 are not suitable.

Key Words: ABEM SAS 300 terrameter system, Geo-electrical, ground water, resistivity, Schlumberger Array, VES, water.

1 Introduction

Water is defined as a chemical compound made up of hydrogen and oxygen in the ratio of 2:1 with chemical formula H_2O. In the planet earth, the part that is made up of water collectively is called the hydrosphere; it refers to the water masses including rivers, seas and oceans. It occupies 70% of the total earth crust by volume. It holds water in form of solid, liquid and gaseous states. Water on the earth system is found in the atmosphere, surface of the earth and beneath; are known as atmospheric-, surfaces – and ground-water respectively.

Hydrologic cycle is a vast and complex system which circulates water over the whole planet earth, which both starts and ends up in the ocean. Energy from the sun powered the system causing water to evaporate from the surface of the world's oceans which then vapourises to form large masses of clouds, when condition is favourable, water precipitates falling back to earth surface again as rain, hail, sleet or snow.

Some of the water fall on the land collect to form streams and rivers which eventually flow back into the seas and oceans from where the process start up again. Not all the rain fall contributes to the flown of streams and rivers in the same way, some of it returns to the atmosphere as evaporation from oceans, ground surfaces and transpiration from the plants. The reason why groundwater has

ISSN 2229-5518

become more popular as a source of potable water in Nigeria is due to its quality when compared to other water sources. It is known to be free most times from pollutants and hence requires little or no decontamination before use.

[1] noted that groundwater is most generally free from odor, color and has very low dissolved solid. It is also not usually affected by natural factors such as drought. The search for ground water has become imperative in human history. This is due to the fact that government and well-to-do individuals are unable to meet the over increasing water demand; inhabitants have to look for alternative means of portable water supply.

Jalingo Local Government Area of Northern Taraba State, Nigeria is known to have persistence water scarcity problem that need to be tackled urgently. Although there are other sources of water such as pit water sources, streams, rivers, open hand-dogged wells, hand pumped and motorized boreholes, these are grossly inadequate for the teaming population. To tackle the problem this research paper has chosen vertical electrical sounding(VES) method; it was chosen because of its excellent vertical resolution and good depth sensitivity, simple instrumentation, easy field logistics and relatively economical, [2].

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2. Study Area

The study area,Jalingo local government in the northern Taraba state, Nigeria lies between latitudes 8^0 50' 0"N to 9^0 5' 0"N and longitudes 11^0 12' 0"E to 11^0 25' 0"E as shown in Figure 1.

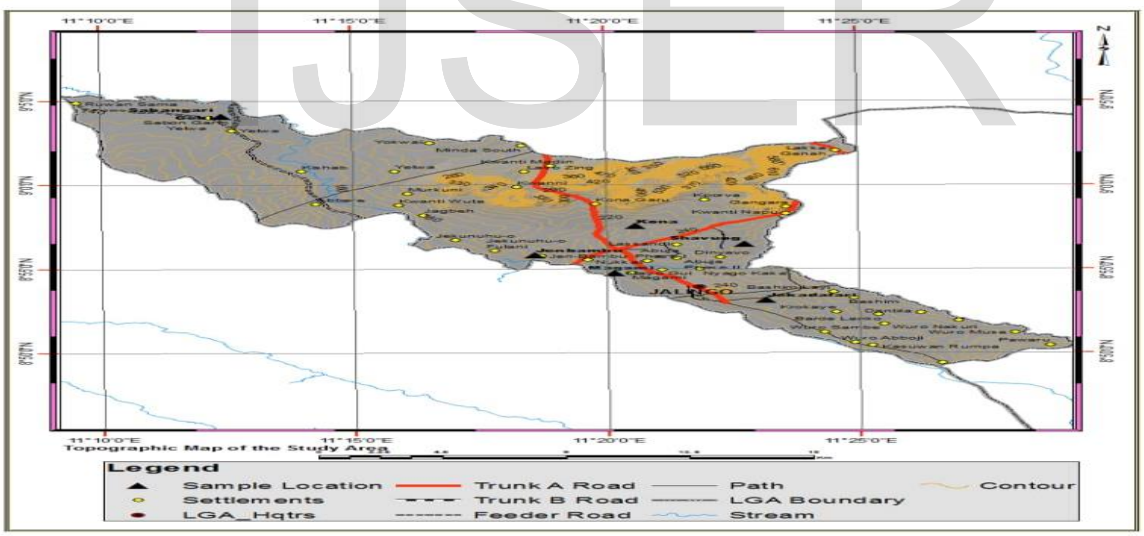

Figure 1: Topographic map of the study area (GSN, 2006)

3. Geology and Hydrogeology of the Study Area

The Taraba State area is made up of both the Basement complex and the Sedimentary Basin. Generally, the Basement complex of Nigeria comprises of:-The Basement complex of North Western Nigeria, the Basement complex of Southern Nigeria, and that of North Eastern Nigeria while Sedimentary Basin comprises of the Sokoto (Illumedeen) basin, the Chad Basin, the Niger-Benue Trough and the Dahomy Basin. However, Jalingo Local Government area fall under Taraba area which is part of the Basement complex of North Eastern Nigeria and Sedimentary Basin of the Benue Trough. This block is known to be composed of the migmatite-gneisses-quartzite complex of which have been intruded by intensive bodies of Pan Africa granites. Meta sedimentary belts are conspicuously absent in this block. Only relics of the meta sedimentary are found as xenoliths [3].The geophysical survey report for ground water investigation project by Taraba State Rural Water Supply and Environmental Sanitation Agency (TSRWESA). The area as characterized by basement complex rock limit, some portions of which are non-aquiferous. The existing well-record shows that immediate environs have shallow localized restricted acquifers which are seasonal. Ground water occurs within the overburden weathered rock of the basement. [4]. The geologic formations of the study areas are shown in figure 2.

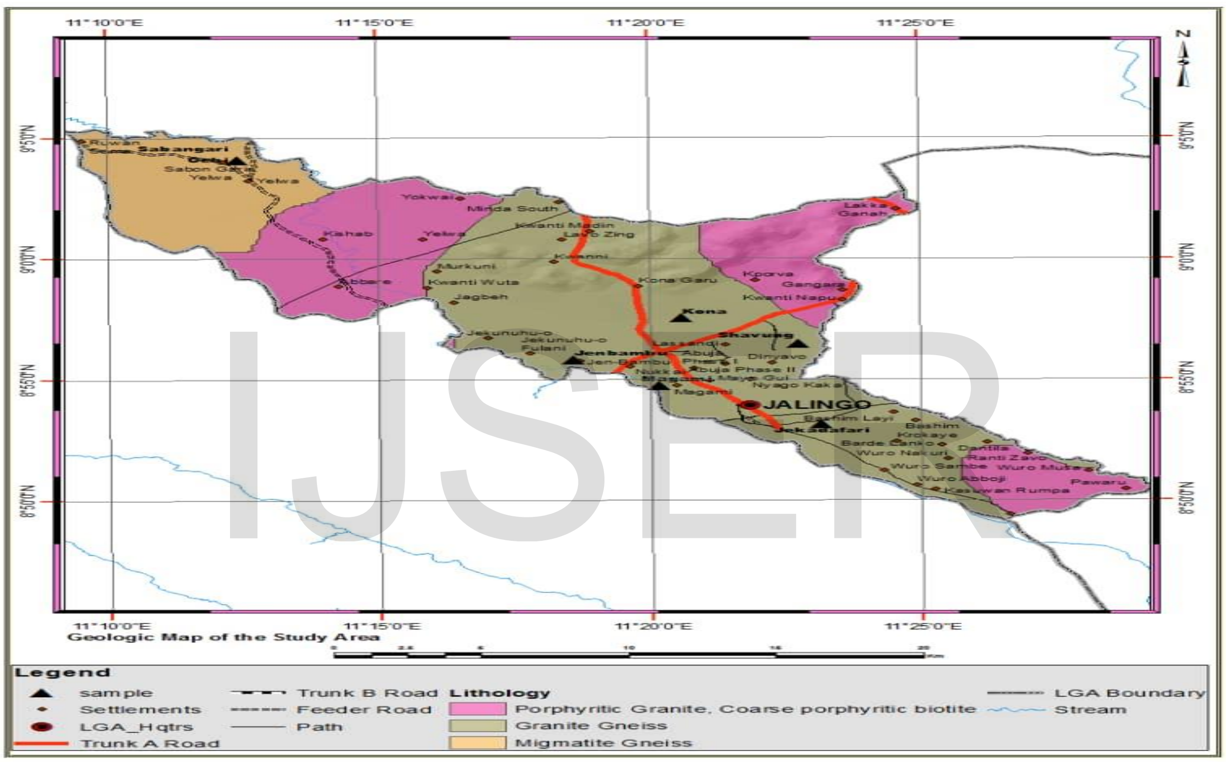

Figure 2: The Geologic map showing geologic formations of the study area (GSN, 2006).

4. Materials and Methods.

The materials used during this work include ABEM Terrameter SAS 300 system, two brass rods, OFFIX-TM, Hammer, water.

Two methods were adopted in this research work which includes: -Reconnaissance survey:In this, two brass rods ere held at parallel at the level of the chest as one traverse along the survey line, the rods usually attracts or repel each other. The greatest angle of attraction indicates the most probable point of the existence of the ground water. It is then at this point the center of the array is located and subsequently Vertical Electrical Sounding.

- VES method: VES was then carried out in ten locations within six satellite villages namely Jekadafari, Jenbambu, Kona, Magami, Sabongari and Shavung with the distribution as follows: three (3) each in Sabongari and Shavung with one (1) each in Kona, Magami, Jekadafari and Jenbambu.

The Schlumberger electrode configuration was used, with maximum current electrode separation (AB/2) of 100m. The instrument, in this array measures vertical changes in ground resistivity with depth.

This is the preferred way to locate vertical layers and aquifers thicknesses. The principle of the resistivity methods is that an electric current is passed into the ground through two current electrodes and the resulting potential difference is measured across two potential electrodes. The resulting potential difference and the current effect is displayed by the digital resistivity equipment as a ground resistance called resistivity. The electrode spacing is progressively increased, keeping the center point of the electrode array fixed. At small electrode spacing, the apparent resistivity is nearly the resistivity of the surface material, but as the current electrodes spacing increase the current penetrates deeper within the subsurface and so the apparent resistivity reflects the resistivity of the deeper layers as well. The apparent resistivity values are obtained by multiplying the measured ground resistance with an appropriate geometric factor to and obtained the apparent resistivity values displayed in tables (1) and (2). The result was interpreted using OFFIX-TM computer geo-electric interpretational software.

5. RESULTS AND DISCUSSION

5.1. Apparent resistivity

Fifteen VES were carried, five each from Jalingo, Yorro and Zing Local Government Areas. The apparent resistivity field values for each VES was recorded in field record sheets. These values were multiplied by schlumberger geometric factor, K= πa^2/b, apparent resistivity values for each VES point location were computed as shown in tables, 1 and 2.

Table 1: Apparent resistivity values

S/N	AB/2 (m)	VES 01 P(Ω*m*)	VES 02 P(Ω*m*)	VES 03 P(Ω*m*)	VES 04 P(Ω*m*)	VES 05 P(Ω*m*)
1	1.00	221	470	406	248	216
2	1.45	208	352	384	179	187
3	2.15	177	300	339	156	194
4	3.15	176	254	280	154	219
5	4.65	183	291	248	161	202
6	6.8	196	332	215	173	399
7	6.8	231	390	221	181	402
8	10.0	314	411	237	204	472
9	14.5	425	511	296	241	594
10	21.5	472	662	393	334	782
11	31.4	561	600	540	365	885
12	31.5	570	670	510	370	901
13	46.5	707	783	792	321	1232
14	68.0	727	867	994	307	1732
15	100.0	1137	1054	1167	290	2163

Table 2: Apparent resistivity values

S/N	**AB/2(m)** (m)	**VES 06** P(Ω*m*)	**VES 07** P(Ω*m*)	**VES08** P(Ω*m*)	**VES09** P(Ω*m*)	**VES10** P(Ω*m*)
1	1.00	308	150	782	2206	980
2	1.45	284	184	702	2302	950
3	2.15	302	164	608	1894	673
4	3.15	307	156	586	1762	562
5	4.65	314	176	424	920	459
6	6.8	443	190	300	549	356

7	6.8	451	200	287	447	341
8	10.0	492	227	254	298	292
9	14.5	635	290	384	302	286
10	21.5	672	388	328	358	279
11	31.4	927	461	488	402	343
12	31.5	951	461	530	420	382
13	46.5	1183	460	767	470	425
14	68.0	1182	793	983	746	793
15	100.0	1263	872	1152	972	871

5.3 Geo-electric Parameters.

The apparent resistivity values for each of the ten VES stations were plotted against half the current electrodes spacing using bi-logarithmic scale and OFFIX-TM undergoes modeling program and iteration process until smooth layered model were obtained then compared to H-,K-,A-,Q- curve types. The H-,Q- curve type or their combinations, with other curve types exhibit the most probable existence of aquifers hence availability for the existence of ground water. In the study area the characteristics curves of resistivity data obtained from ABEM SAS 300 terrameter system analysed by using OFFIX-TM generally shows three to four layers with resistivity ranges as follows: first layer(Resistive top soil) ranges from 165.4 to 2446.9 , second layer (Saturated zone) ranges from 144.0 to 2578.9 while third and the fourth (Resistive basement) ranges from 343.9 tobe7359.0 over the selected locations in the study ate. It was also found that in the study area VES 02, 03, 04, 08, 09, 10 are the H-types which constipated 60% while VES 01, 05, 06, 07 are the A-types that also constipated 40%. It is recommended that those locations with with H-type ccurves are suitable for drilling sites while those with A-type curves are not suitable sites.

Conclusion and Recommendation.

The geo-physical method used in the paper have greatly assisted in evaluating ground water potentials in Jalingo Local Government Area. The geo-electric parameters that favour presence of ground water are low apparent resistivity, large thickness and weathered or fractured geo-electric section. In light of this statement the VES stations for suitable drilling sites in the study area: 02, 03, 04, 08, 09 and 10 while 01, 05, 06 and 07 are not suitable sites for drilling.

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